

ACHIEVING THE GOALS

Mechanisms

In addition to the specific actions noted above, CMMI will use the following mechanisms to accomplish its objectives:

- *Unsolicited research grants:* Grants to fund unsolicited research are the mainstay of NSF operations. The division's success hinges largely on attracting and funding high-quality research proposals.
- *SGER awards:* The SGER mechanism enables program directors to initiate research in totally new areas, and to conduct research on fleeting phenomena that otherwise would be lost. Using the SGER award, a program director can discuss ideas with PIs, encourage them to submit a proposal, and provide seed money to get research started quickly, even when the idea is so new that no base of reviewers exists to evaluate it. In the case of fleeting phenomena, such as earthquakes and tsunamis, SGER awards enable the division to react quickly to gather perishable data for later analysis.
- *CAREER awards:* CAREER awards provide a mechanism for the division to enable young faculty to initiate their careers in a positive way. The CAREER award supports a first step from Ph.D. dissertation research into new areas of independent research.
- *Solicitations, particularly through the Office of Emerging Frontiers in Research and Innovation (EFRI) Division:* Solicitations allow the division to encourage research in specific areas and to collaborate with other agencies in areas of mutual interest.
- *Collaborations with other federal agencies:* In areas of common interest, it is possible for the division to team with other federal agencies to create special initiatives and to co-fund research. Sometimes, other federal agencies will allow NSF PIs access to unique equipment for experimental or computational research. Sometimes, NSF PIs can collaborate with researchers from national laboratories or other federal agencies.
- *Supplements such as REU, RET and IREE (International Research in Education and Engineering):* Supplements can be used to accomplish several specific objectives, such as the involvement of students, outreach to K–12 teachers, or initiation of international collaborations.
- *Selection of reviewers by program directors:* A key duty of a program director is to select an appropriate set of reviewers for each proposal, and it is the principal way that a program director assures a competent and unbiased review for each proposal. But, through the selection of reviewers, program directors can

accomplish more than just the review of proposals. For example, when young faculty or other experts that have never been on a review panel are selected as reviewers, they can better understand the NSF system and thus write better proposals themselves.

- *CMMI Grantees Conference*: CMMI sponsors a grantees conference every 18 months so that PIs can meet each other, become familiar with the research of their peers, potentially form collaborations, and hear about new NSF opportunities. The conference also affords an opportunity for NSF program directors to meet their grantees and review their progress in person.
- *Agenda-setting workshops*: Workshops to advise NSF Program Directors on appropriate research emphases are valuable mechanisms not only for establishing research program agenda, but also for informing potential PIs regarding program priorities. Reports of agenda-setting workshops provide guidance, particularly for young PIs, on what more senior researchers in their fields perceive as important. These workshops can also be the source of ideas for transformative research.
- *Workshops on writing proposals and developing research programs*: Many faculty find proposal writing difficult and challenging. Although several privately administered workshops provide assistance in learning to write a good proposal, the best advice comes directly from NSF program directors. These workshops enable NSF to provide assistance to targeted groups, such as EPSCoR states or underrepresented minorities, to enable these PIs to become more competitive.
- *Papers by program directors leading their fields*: Program directors have access to information or insights that could benefit their research community, often because of the overview position they hold. A program director might write a paper that can help guide the research community or provide insights that will enable the community to propose and perform better research.
- *Conference sponsorship, especially to enable student participation*: Although the division does not generally support conferences, it does provide support for conferences centered around entirely new areas of research, and it frequently provides support for student participation in conferences. This support may take the form of travel grants and may include a paper contest or other such competition designed to engage students and garner their interest and enthusiasm.
- *Program director, division director and deputy division director outreach to academic institutions*: The division's leadership team may participate in outreach with academic institutions. Outreach can include site visits to active PIs, the presentation of seminars, discussions of NSF opportunities, one-on-one time with prospective PIs, and in some cases assistance with proposal writing workshops held on campus.

- *Sponsorship of contests and competitions:* The division has historically provided support for a few competitive student activities that garner student interest and enthusiasm. Two examples are the support of a student design competition through the Society of Hispanic Professional Engineers and the Challenge X competition co-sponsored by the Department of Energy, the automotive industry and collaborating industries.
- *Interdisciplinary connections enabled by Program Directors:* Program Directors are often in positions to identify effective collaborations that cross disciplinary boundaries. They can facilitate such collaborations and encourage interdisciplinary research using grant mechanisms such as SGER awards.
- *Participation in cross-directorate and NSF-wide activities:* CMMI program directors commonly participate in cross-directorate activities, such as EFRI, and NSF-wide activities such as cyberinfrastructure and mathematics initiatives. Such participation helps to make multidisciplinary connections and may bring additional funds into the division.
- *Recognition awards:* NSF-wide awards, such as the Alan T. Waterman award, may be given to PIs in recognition of outstanding research and educational contributions. Awards help identify for the research community those activities that the Division feels are particularly noteworthy, and provide a guiding light for younger faculty.
- *One-on-one meetings with PIs and students:* Program directors can meet on the phone or in person with PIs to help them in many ways. They can give encouragement, guidance, mentoring and advice, and help PIs make connections and better understand NSF. They can provide valuable insights on the interpretation of proposal evaluations.
- *Committee of Visitors (COVs):* COVs give guidance and recommendations to the division on a three-year cycle.
- *Highlights:* Highlights are summaries of the outcomes of ENG-funded research. They provide a window that looks back to success stories and allows reveals what research works and what research spawned transformative technologies.

Collaborations

Collaborations enable CMMI's program officers to participate in larger-scale initiatives throughout NSF and beyond that could lead to breakthroughs that may not be possible with the division's limited financial resources. These collaborations also allow CMMI program directors to provide technical expertise and knowledge to foster new areas and concepts through the engineering and collaborative disciplines. CMMI's 20 programs participate in some form of collaboration to leverage both financial resources and program director knowledge and talent. These collaborations occur as intra-cluster and

intra-divisional partnerships, as NSF-wide collaborations for funding and development of initiatives, and as collaborations with other federal agencies, nongovernmental agencies and international agencies.

INTERNAL CMMI COLLABORATIONS

CMMI's diverse research programs regularly collaborate in the review and co-funding of proposals. The clustering of programs with similar or related research priorities are a means of enabling easier collaboration in the review of proposals and development of cross-cutting areas of research priority. This clustering allows for optimal use of each program's funding allocations and for greater funding for worthy proposals.

One program that actively participates in intra-cluster and inter-divisional co-funding is the Materials Processing and Manufacturing Program (MPM). MPM works closely with other programs in its Materials Transformation and Mechanics Cluster in making funding decisions on proposals of interest to both programs. MPM co-funded awards with Manufacturing Machines and Equipment program (MME), and has also co-funded CAREER grant writing workshops with MME and other division programs.

COLLABORATIONS WITHIN THE DIRECTORATE FOR ENGINEERING AND ACROSS NSF

The CMMI program directors participate actively in initiatives throughout ENG and across NSF. CMMI leads NSF in coordinating research efforts in sensor technology for detection and prediction of explosives via the NSF-wide Explosives and Related Threats solicitation. As leaders in developing topics across ENG, CMMI Program Directors are active participants and leaders in the EFRI division.

Many programs focus on the ENG- and NSF-wide initiative to apply nanotechnology to various aspects of their programs, supporting NSF's efforts as the lead in the National Nanotechnology Initiative (NNI). Several programs fund proposals and help coordinate and manage various nano-related solicitations and awards throughout ENG.

CMMI programs also routinely collaborate with other programs in other ENG divisions to review and fund proposals. For example, the MPM program regularly holds a panel with the Thermal Transport/Thermal Processing (TTP) program in CBET to evaluate some unsolicited proposals. It is common for the two programs to co-fund one or two proposals. The Control Systems program also collaborates with the Power, Controls and Adaptive Networks (PCAN) Program in ECCS in the co-review and co-funding of proposals.

CMMI programs also collaborate with other research programs throughout NSF.

- The Mechanics and Structures of Materials (MSM) program collaborates with

CBET and EEC.

- The sensors program works with the Applied Mathematics program of MPS on funding research in sensors and smart materials technologies.
- The Structural Systems and Hazards Mitigation program has planned collaborations with the Atmospheric Sciences program in the Directorate for Geosciences (GEO).
- The MPM program has collaborated with the Ceramics Program in the Division of Materials Research (DMR) to co-fund two Focused Research Group (FRG) proposals in the past funding year.
- CMMI's Geoenvironmental Engineering and Geohazards Mitigation program is co-funding a workshop with CBET and another workshop with CBET and the Division of Earth Sciences (EAR) in GEO.
- Two program officers are involved in managing CMMI co-sponsored projects in the NSF-wide initiative Dynamic Data Driven Applications Systems (DDDAS).
- Misawa is also involved with is the aforementioned prediction of explosives and related support of research on threats.
- Other collaborations outside of ENG within NSF include collaborations with Social, Behavioral and Economic Sciences (SBE) on support for dynamics-based investigations of human behavior, proposals related to the Service Enterprise Engineering (SEE) program, and collaboration with MPS/DMS on aligning program focus coordinating workshops.
- CMMI programs routinely collaborate with the Grant Opportunities for Academic Liaison with Industry (GOALI) program to co-fund proposals that have significant industry partnerships. Several standard grants are being funded for FY 2007 throughout CMMI, including one in the MPM program that will fund a visiting researcher from an industrial partner to work at a university site to conduct research.

INTERNATIONAL COLLABORATIONS

Most programs also collaborate with the Office of International Science and Engineering (OISE) in funding workshops and student exchange programs, especially through the IREE supplement program. This supplement provides funding for a student to perform research in collaboration with an international research partner. The Sensors and Sensor Networks program is a good example of this collaboration with leveraged funding for student programs to Japan, Taiwan, China, Korea, and throughout the European Union.

The MPM program regularly works with this NSF office in offering evaluations and opinions of proposals pertaining to its research focuses. Collaboration is also occurring with OISE through a sponsored workshop by the Information Technology and Infrastructure Systems program.

The program director for Dynamical Systems program has been working with OISE on developing collaborations with researchers in Brazil and Japan as well as working in leading the ENG-wide initiative to secure seed funds for the Engineering Virtual

Organization grants program.

Another notable collaboration between a former CMMI program director and OISE has occurred through the initiation and development of the East Asia and Pacific Summer Institute (EAPSI) program for Singapore. His activities in starting this center included making contact with Singaporean universities, participating in drafting the EAPSI-Singapore agreement with the National Research Foundation (NRF) of Singapore, participating as a member of the NSF team in conference calls with NRF staff, and giving a presentation in April 2007 at the EAPSI student orientation.

COLLABORATION WITH OTHER FEDERAL AGENCIES AND BEYOND

In addition co-sponsoring support of research projects and initiatives through collaboration with NSF organizations, CMMI programs also have leveraged funds in cooperation with other federal agencies. For example, the MPM program has collaborated with the **Department of Energy** (DOE) to co-fund six research awards in the area of polymer composite processing and manufacturing. These grants are now in their third year. The MPM program is currently collaborating with DOE and three other programs in CMMI (Infrastructure Materials Applications and Structural Mechanics, Materials Design and Surface Engineering, and Mechanics and Structure of Materials) and the Division of Materials Research to review and co-fund proposals in the area of Advanced High Strength Steel (AHSS). The group has also co-funded (along with an industrial partnership with auto and steel companies) a workshop to identify and discuss the fundamental research challenges in the area of AHSS. Proposals were reviewed in April 2007. CMMI also collaborates with DOE through a partnership with its **Sandia National Labs** in a multi-year joint initiative on life-cycle engineering.

Many of CMMI's programs interact with the various research offices of the **Department of Defense (DOD)**. These collaborations include a partnership between CMMI's Sensor Innovation program and most Department of Defense agencies on autonomous engineered systems for mitigation of threats. The Nano-Biomechanics program has also collaborated with DOD agencies including the Office of Naval Research, the Army Research Office and the Air Force Office of Sponsored Research in funding a workshop on Smart Systems for Mitigation of Exogenous Threats Using Autonomic Response. CMMI's Dynamical Systems program participants in several defense related collaborations in the realm of prediction of Improvised Explosive Devices, and also co-funds joint workshops and co-reviews proposals. This program is also involved in a collaboration with the **Department of Homeland Security** in funding work focused on predicting and detecting of nuclear devices.

Additional collaborations with several other federal agencies include sponsoring research initiatives as well as workshops for setting research agenda. One such collaboration is an ongoing multi-agency and multi-program effort in the development of Simulation-Based Engineering and Science that also includes the **World Technology Evaluation Council** (WTEC), a nongovernmental organization.

Additional collaborations exist between the Infrastructure and Structural Mechanics program and the **Federal Highway Administration** (FHWA) on Long Term Bridge Performance, and the **U.S. Department of Agriculture's** Forest Products program on nanotechnology in timber products. The Structural Systems and Hazards Mitigation program collaborates with NIST on fire research.

Another program with much collaboration within the Federal government and beyond is the Mechanics and Structure of Materials program. It has recently collaborated with the Air Force Office of Scientific Research, the **Army Research Laboratory**, Sandia National Labs, the **National Institutes of Health (NIH)**, nongovernmental organizations such as WETC, and Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT).

The MPM program is involved in an interagency working group for Metals and for Polymers as well, and the Materials Design and Surface Engineering program is involved in the Interagency Metals Research Group. One other novel collaboration exists between the Dynamical Systems program and the U.S. Department of State. This program's director serves on a joint commission on science and technology with Brazil and coordinates activities with the Brazilian Embassy in such activities.

Several programs have collaborations with NIH institutes. The MSM, Nano-Biomechanics, and Materials Design and Surface Engineering programs collaborate with NIH and many others in the **Interagency Modeling and Analysis Group (IMAG)**. This collaboration includes monthly meetings to discuss progress of the program Multi-scale Modeling in Biomedical, Biological and Behavioral Systems, participating in organized seminars, and attending the program's grantees conference. SEE has also collaborated with NIH by sponsoring a workshop with the **National Institute of Biomedical Imaging and Bioengineering (NIBIB)** in June 2006.

Management

The division also pursues its goals through its management, mainly through organization and policy.

Organization

In concert with its objectives, CMMI constantly will evaluate its organizational structure and be amenable to change whenever appropriate (although not necessarily frequently). CMMI seeks to achieve an organizational structure that accomplishes the following objectives:

- To be flexible and responsive to the research community that the division serves
- To accommodate innovation and to provide an opportunity for the funding of novel and innovative engineering research and educational projects

- To be a leader in innovation, and to encourage the research community to move into and take advantage of new research areas and recent breakthroughs
- To provide clarity to the research community, providing well-defined distinctions for research funding opportunities and research programs
- To foster the effective use of division resources
- To minimize duplication of effort and to enable the research community to make effective use of research results across disciplines

Policy

The division sets policy that is intended to accomplish the following objectives:

- Promote consistency across the division, consistent with the policy of NSF and ENG.
- Promote transparency of the division's operations, particularly in its dealings with the outside community
- Promote predictability in the division's dealings with its community, particularly in its enforcement of the policies of NSF and ENG
- Promote equity and fairness in the treatment of all individuals, both within the division and within the community it serves.
- Promote efficiency in the division's operation

To promote its policy, the division has established a Web page where division staff can go to determine best practices and policy. For example, these policies include the division's interpretation of the NSF Grant Proposal Guide (GPG) and the extent to which the division will return without review proposals that do not meet GPG requirements. The site also helps in division staff work to assure that REU and RET supplements are awarded consistently across the division.

Work Performance Standards

The division seeks to establish work performance standards for its staff. These standards are intended to set minimum expectations so that all members of the division understand their responsibility to the other division members and their roles in accomplishing the division's goals and objectives.

Oversight and Accountability

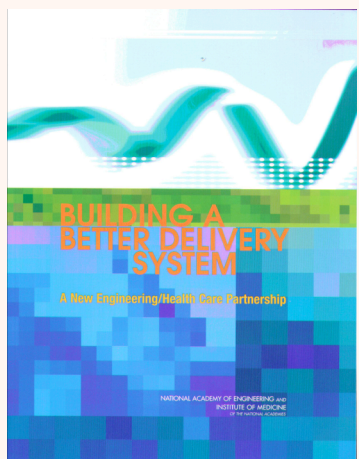
The division uses several mechanisms to accomplish oversight and accountability. The major oversight function is the triennial Committee of Visitors review. The first review is scheduled for the division's third year of operation in spring 2009 . This review will be conducted in accordance with all applicable NSF procedures in place at the time of the review.

The division also supports assessments and evaluations of activities and research areas through studies by the National Academy of Sciences and professional societies such as the American Society of Mechanical Engineers, the American Society of Civil Engineers (ASCE), American Academy of Mechanics (AAM), Materials Research Society (MRS) and WTEC. These studies provide insights into research areas not covered by division funding, and outlines areas of opportunity in which additional or focused funding would be particularly effective.

Individual programs or groups of programs may also, from time-to-time, support *ad hoc* workshops to assess individual research areas and to make recommendations to the respective program directors on research agenda and program priorities.

Individual programs generally fund studies and assessments. However, consortia of programs and agencies may also fund studies that may be the basis for later collaboration between the funding agencies. WTEC studies are a good example.

In addition to seeking external controls and oversight, the division also works to guard against waste, fraud and abuse, both from within and across its research community. Frequently, reviewers are the guardians of abuse for the research community. Reviewing new proposals in light of prior NSF support and accomplishments provides a quality control mechanism for future awards. Reviewers are also encouraged to report instances of plagiarism, patent infringement or breach of confidentiality. Such cases are reported to the NSF Inspector General for further investigation and resolution. Where possible, the internal management of the division will be structured to guard against waste, fraud and abuse from within as well. The division will use NSF accounting and program management tools to guard against abuses from within, and the division director and deputy division director will jointly monitor expenditures such as travel and equipment purchases.



CMMI sponsored a report by the National Academy of Engineering and the Institute of Medicine on the application of engineering principles to the delivery of health care. The report found that a systems engineering approach using such techniques as statistical process controls, queuing theory and failure-mode effects and analysis should be used to transform the U.S. health care sector.

<div> <div>Mechanisms</div> <div>Goals</div> </div>	One on one meetings with PIs and students	Recognition Awards	Participation in cross-directorate and cross-Foundation activities	Interdisciplinary connections enabled by Program Officers	Sponsorship of contests and competitions	Program Director, DD and DDD outreach to academic institutions	Conference Sponsorship, enabling student participation	Papers by Program Officers leading their fields	Proposal writing and research program development workshops	Agenda-setting workshops	CMMI Grantees Conference	Supplements (REU, RET, IREE)	Collaborations with other Federal Agencies	Solicitations, especially EFRI	CAREER Awards	SGER Awards	Unsolicited Research Grants
	Discovery																
1		X	X	X	X	X		X	X	X			X	X	X	X	X
2			X	X		X		X		X				X		X	
3			X	X		X		X					X	X		X	
Learning																	
4		X	X	X			X					X			X		X
5																	
6		X	X	X			X	X	X	X	X	X				X	X
Research Infrastructure																	
7				X	X		X	X			X		X	X			
8		X	X		X			X	X				X				
9				X													
Stewardship																	
10		X	X	X	X	X	X	X	X	X	X					X	X
11		X	X	X	X	X						X					
12		X	X	X	X												
13							X	X	X								X
14																X	X

This matrix correlates CMMI's goals to particular mechanisms available to achieve these goals.